

LESSON 4: Making Recycled Paper by Hand

LESSON'S CONCEPTS

- Waste paper can be made into recycled paper in order to conserve trees and space in landfills.
- Buying products made from recycled materials continues a cycle that conserves natural resources.

PURPOSE

Students will learn how to make recycled paper. Students will also identify how buying recycled products “closes the loop.”

OVERVIEW

In this lesson students will:

- Listen to descriptions and conclude that most paper is made from trees.
- Observe various types of paper with a magnifying lens.
- Use various steps involved in recycling wastepaper by making their own recycled paper in the classroom.
- Make planters out of recycled paper and plant seeds or seedlings.
- Look for the symbol on products that indicates the product is made from recycled material.
- Discuss how “closing the loop” benefits the environment and people.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS AND TO THE BENCHMARKS FOR SCIENCE LITERACY

- Students compare similarities and differences in types of paper, including those made from recycled fibers, after they observe these with a magnifying lens.
 - “Magnifiers help people see things they could not see without them.” (*Benchmarks for Science Literacy*, page 111)
- Students work in groups to make recycled paper. They read directions.

- “Many materials can be recycled and used again, sometimes in different forms.” (*Benchmarks for Science Literacy*, page 119)
- “Several steps are usually involved in making things.” (*Benchmarks for Science Literacy*, page 188)
- “To participate effectively in society, students need to: Develop personal skills . . . group interaction skills . . . (and) social and political participation skills.” (*History–Social Science Framework*, page 24)
- “Students know about letters, words, and sounds, and they apply their knowledge in reading simple sentences.” (*California Language Arts: Reading, Writing, Listening, and Speaking Content Standards for Grades K–12; Kindergarten; Reading: Word Analysis, Fluency, and Systematic Vocabulary Development, Standard 1.0*)
- “Students create original artworks based on personal experiences or responses.” (*Visual and Performing Arts Framework; Visual Art: Creative Expression Component, Goal 4, page 101*)
- Students draw and write descriptions of how to make recycled paper.
 - “Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept . . . students will: draw pictures that correctly portray at least some features of the thing being described.” (*Science Content Standards, Grades K–12; Grade 1; Investigation and Experimentation, Standard 4a*)

- "... write or draw descriptions of a sequence of steps, events, and observations." (*Science Content Standards, Grades K–12*; Grade 2; Investigation and Experimentation, Standard 4d)

SCIENTIFIC THINKING PROCESSES:

observing, communicating, comparing, ordering

TIME:

60 minutes to prepare for the lesson and to prepare the paper pulp; 45–60 minutes per day for two days to implement the lesson, plus 30 minutes three days later (or whenever the recycled paper in the planter is dry) to plant seeds

VOCABULARY:

"closing the loop," conserve, pulp, pulp slurry, virgin paper

PREPARATION

Note: It is recommended that only "Part I-A, Making a Paper Planter" be completed by students in kindergarten and grade one; and both "Part I-A, Making a Paper Planter" and "Part I-B, Making Recycled Paper" be completed with students in grades two and three.

___ 1. Read the "Background Information for the Teacher" at the end of this lesson.

___ 2. The day before you plan to do this lesson, have each student prepare to make a paper planter by tearing two full pages of newspaper into one-half to one inch pieces. Fill buckets or pans with one part newspaper pieces and three parts water. Let the mixture sit overnight. The newspaper pieces will be soft and ready to be pulped the next morning.

Note: By soaking the mixture overnight, a blender will not be needed for making the paper planter. Then the blender can be used solely for the activity of making recycled paper. For younger students (in kindergarten and first grade), a blender will not be necessary, and you will not need to complete "Preparation" #2 and 3.

___ 3. Either make one transparency of, or make a copy and consider laminating, "Steps to Make Recycled Paper" (page L4–14x). (If you are using two blenders, you will need to make two copies of the "Steps.")

___ 4. Make a transparency of "Closing the Loop: The Meaning of Recycling Symbols" (page L4–16x).

___ 5. Obtain enough window screen to cut several rectangles, approximately 8 inches by 10 inches. Most hardware stores will donate pieces of old screen. You can also buy a roll and share with other teachers. Cut the window screen into rectangles approximately 8 inches by 10 inches.

(Larger or smaller sizes of screen can also be used.) Place duct tape around the cut screen to cover rough edges and to make the edges stiffer. If you have access to half-inch wood strips to use for framing the screen, staple the screen onto the wood.

MATERIALS

For "Pre-Activity Questions"

___ The book *Be a Friend to Trees* by Patricia Lauber or a similar book that describes the fact that trees are cut and their wood pulp is used to make paper

___ Sample of various paper, some of which is made from recycled fibers (for example: chipboard (cereal box), made from recycled fibers; magazine (coated with clay); newsprint (most newspapers will note their paper has recycled content); white office paper (if available, obtain some made from recycled fibers); construction paper. Also if available, provide an example of recycled paper made by students.

___ Magnifying lens (one for each pair of students)

___ If available, a microscope

For "Part I-A, Making a Paper Planter"

___ Small milk cartons (6-ounce size), rinsed and top cut out; or yogurt containers, one for each student

___ A few stacks of newspapers

___ Seeds to plant in the paper planter. Some nurseries will donate seeds. Consider planting native wildflowers or radishes (that students could eat).

___ Approximately one cup of soil for each paper planter

For "Part I-B, Making Recycled Paper"

- ___ Several 8 inch by 10 inch pieces of window screen
- ___ Duct tape or wooden frames for each screen
- ___ Scissors
- ___ Two or more two-gallon plastic dishpans
- ___ Two or more large slotted spoons (depending on the number of dishpans)
- ___ One or two blenders (to speed up the process, obtain a ratio of one blender for up to three plastic dishpans)
- ___ A copy of “Steps to Make Recycled Paper” for each blender
- ___ Scraps of white and colored paper
- ___ Several towels or sponges (or additional newspaper for removing excess water)

Note: If students plan to write on their recycled paper, consider adding some liquid fabric starch to keep the ink from spreading.

Optional:

- ___ An embroidery hoop, a wooden picture frame, large cookie cutters, and/or a coffee can (with both ends removed) to be used as frames for a screen
- ___ Leaves, flowers, potpourri, and/or food coloring (to add to the recycled paper that students are making)

For “Part II, Buying Recycled Products”

- ___ An example of the symbol that indicates that a product is made from recycled material from a cereal box or other product
- ___ The transparency, “Closing the Loop: The Meaning of Recycling Symbols” found on page 70

Optional:

- ___ The video, *Kids Talking Trash*
- ___ A video on how paper is made (see “Resources”)

For “Application”

- ___ The book *Where Does the Garbage Go?* by Paul Showers

PRE-ACTIVITY QUESTIONS

- A. The day before making the paper planter, soak a mixture of newspaper and water overnight. (See “Preparation #1.”) Discuss what will happen to the newspaper that is

soaked overnight. *The paper will break up; it will turn white; it will turn “mushy”; its ink will get in the water.*

- B. Read to students pages 5–10 and 30–32 from the book *Be a Friend to Trees* by Patricia Lauber (could be substituted by another book on the same topic). Discuss:
- From what material is most paper made? *Wood* What category of natural resources is wood? *Plants* (Students learned this in the K–3 Module, Unit 1.)
 - What are some other ways that plants are important? *They provide food and shelter to wildlife; people eat plants; people use wood from trees for lumber to build houses and furniture.*
 - Who and what depends on trees and other plants to survive? *people, wildlife*
 - What can we do to conserve (use fewer or avoid wasteful use of) trees? *Use fewer things made from trees; reuse things made from trees; recycle things made from trees.*
- C. Provide samples of pieces of paper made from recycled fibers and from non-recycled fibers (virgin materials).
- Distribute magnifying lenses.
 - Have students examine the various types of paper with their magnifying lenses to identify similarities and differences.
 - If available, allow students to view paper fibers through a microscope.
- D. Discuss with students:
- What do you see when you look at the paper through a magnifying glass? *Bits of stuff; fibers*
 - What differences did you see between paper made with recycled fibers and non-recycled fibers? *You can see the recycled pieces in the recycled paper.*
 - How do you know if something is made from recycled materials? *It says so on the box.* (This information is usually printed on the box or container and includes the three-arrow symbol. See example in “Part II.”)
 - What insect makes paper? *The paper wasp*

PROCEDURE

- A. For “Part I-A, Making a Paper Planter” and “Part I-B, Making Recycled Paper” do the following:
- Separate the class into groups of three or four students.
 - Two groups will make recycled paper,

while all other groups will be making paper planters.

- If you have two blenders, you can have four groups work on the recycled paper while the other groups work on their paper planters.
- Students who complete their planter can cut and/or tear scrap paper into a container while waiting their turn to make the recycled paper.

Part I-A, Making a Paper Planter

Note: The mixture for the paper planter was to be prepared the day before.

- B.** Provide newspapers (to be spread in the work area), a small milk carton (with the top cut) or yogurt container for each group.

Note: For younger students you will need to demonstrate how to make a paper planter.

1. Stir the pulp mixture (which has been soaking overnight) in each bucket or pan until it looks like mush. (Soaking and stirring breaks the fibers down into a form that can be bonded together again to form recycled paper.)

2. Have students:

- Take a handful of the pulp mixture. (They should squeeze as much water out of the pulp as possible back into the bucket or dishpan.)
- Use dry pieces of newspaper to remove the excess water. (This step is very important, or the paper planter will take too long to dry.)
- Use a small milk carton or other container and mold the pulp inside the carton. The pulp should be about one-fourth inch thick.
- Use additional pieces of newspaper to remove the excess water inside the paper mold.

- C.** Allow the planters to dry completely (about three days) inside the carton. You might set these out in the sunlight for a few hours each day.

Once the paper planters are dry:

- Take the handmade paper planters out of the milk cartons. The milk cartons can be reused or also used as planters.
- Provide soil and plant seeds in the planters. If the seeds are from native wildflowers, once they mature, students can take



Students from Lynda Mooney's first-grade class at Las Palmas Elementary School show their paper planter and paper made from recycled fibers.

these home or plant them on the school grounds. If radish seeds were planted, students can wait until the radishes are large enough to eat. Then a salad that includes the radishes can be made for the whole class.

Note: When planting the seedlings, place the entire paper planter with the plant in the ground. The paper planter will decompose.

Project Idea: With the class, plant seedlings, shrubs, and/or wildflowers on the school campus or in a nearby park. The U.S. Forest Service, the California Department of Forestry, and some timber companies and nurseries will often donate to schools seedlings from native trees and other plants. If seedlings are to be planted on the school grounds or in other parts of the community, it is recommended that the species of the seedlings be appropriate for the existing soil and weather conditions where they will be planted. This will ensure a greater survival rate for the plants.

Part I-B, Making Recycled Paper

Note: For younger students, prepare the pulp slurry in advance. For safety reasons, do not allow younger students to work the blender.

Note: Use white and colored scrap paper to make colorful recycled paper. Adding potpourri (be careful not to use potpourri that has soap in



Students in Betsy Weiss's first-grade class at Paden Elementary School work in groups to make recycled paper.

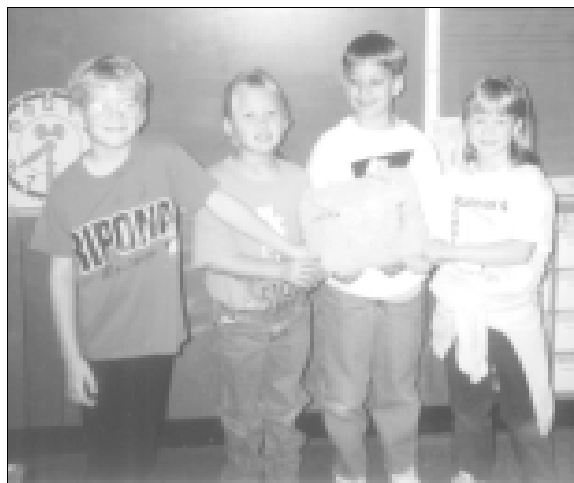
the fragrances because it will make the pulp sudsy), spices, and/or flowers prior to blending the paper will give you the recycled paper texture and scent. You can also use newspaper from which to make recycled paper; then add colored paper, streamers, food coloring, or berries to give you colored recycled paper, although the recycled paper will have a grayish hue.

- D.** Set a copy of “Steps to Make Recycled Paper” by each blender. While the rest of the class members are molding their paper planters, teach the first two groups how to make a recycled sheet of paper. They should follow the directions on “Steps to Make Recycled Paper.” (If you have two blenders, then teach four groups.) When students from the first two groups have completed making the paper, have them teach the students in the next two groups how to make the paper. Then the members of the first group can work on their paper planters. The second group will teach the third group and so on. (Again, if there are two blenders, you can have two groups teach two other groups.)

Note: Adding liquid fabric starch to the pulp will allow students to write in ink on the recycled paper without the ink spreading.

- E.** Have students use a magnifying lens or microscope to examine the recycled paper that they made.

Note: Keep one paper planter and one milk carton to test for speed of decomposition in the K-3 Module, Unit 3.



Students from Ted Schut's first-grade class at Ripona Elementary School show the recycled paper that they had made.

Project Idea: Have students make cards (e.g., for Mother's Day or Father's Day, birthdays, notes) out of recycled paper to give as gifts. Some could be sold for fund-raising purposes.

Part II, Buying Recycled Products

- A.** Show students an example of the symbol that indicates that a product is made from recycled material. Consider showing a section of the video *Kids Talking Trash* that explains how to read a package to determine whether it is made from recycled material.



- B.** Project the transparency “Closing the Loop: The Meaning of Recycling Symbols” and ask students, “If you put paper in the recycling bin represented by the first arrow in the logo for recycled material, and the second arrow represents the making of new paper, what do you think the third arrow means?” *Buying products made from recycled paper.* (You will probably need to lead students through this thought process.)

1. Ask:

- How do you think this “closes the loop”?
The paper doesn't get thrown away into a landfill; it gets made into new paper.

- How do we make sure we are “closing the loop”? *Reuse paper; then recycle it to be made into new paper; then buy products made from recycled materials.*

2. Explain that “closing the loop” is practicing all of the three activities depicted in the recycling loop (i.e., collecting, manufacturing, and buying recycled material). Without any one of those activities, the loop remains open. And if you are not buying recycled products, you are not completing the recycling process.

C. If available, show students a video, photographs, or books with photographs about manufacturing recycled paper.

Homework Assignment: Ask students to look on packaged items for the symbol that indicates that a product is made from recycled material. Then have them list or draw at least two products that contain the recycled content symbol to share with the class the following day. They can bring a box with the symbol or cut the symbol from the box. (**Safety Note:** Students should request the assistance of an adult to cut the symbol from the box.)

DISCUSSION/QUESTIONS

Discuss with students:

- What does the word *conserve* mean? *To keep from wasting; to save*
- How does recycling paper conserve trees? *Fewer trees are needed to make paper because we are using and buying less paper.*
- How does recycling paper conserve landfill space? *Less paper goes into the landfill so it will take longer to fill up.* Inform students that, in California, paper makes up 31 percent of the residential (household) waste stream.
- How does buying or making recycled paper conserve trees and landfill space? *To make recycled paper, less tree pulp is used and less paper is being thrown into the landfill, because the paper is being recycled and used again.*
- Why is it important to buy products made from recycled materials? *Trees are conserved and so is landfill space.*

APPLICATION

A. Have students determine how the recycled paper they made could be used; e.g., as a

greeting card, for a sign. Then ask them to use the recycled paper they made for a specific purpose.

- B. The following should be discussed with older students:
- Describe what “closing the loop” means. *Placing recyclable items into a bin for collection, having the manufacturing companies make new items with the recycled product, and buying recycled products.*
 - How does “closing the loop,” by buying recycled materials, conserve natural resources? *Fewer natural resources are needed to make things from recycled materials (e.g., recycled paper) than it takes when those same things are made from raw materials (e.g., tree pulp).*
 - How does “closing the loop” benefit people and the environment?
- C. As a class, make a list of the benefits of recycling paper and using recycled paper, and share the information with another class. Also list the benefits of reusing paper.
- D. Show students page 24 in the book *Where Does the Garbage Go?* by Paul Showers. Have students compare the papermaking steps they used with those used by the paper mills in the manufacture of recycled paper. Or have students use pictures, labels, and short phrases to create a poster describing the benefits of recycling paper.
- E. Ask students to draw and write descriptions of the sequence of steps of how to make recycled paper.

Project Idea: Encourage students to come up with ways to demonstrate that recycled paper (made from recycled paper fibers) can be as good as virgin paper (made from wood pulp). They can test for strength, color, absorption. Have students summarize their results in a chart. This chart can be used to encourage students, parents, and school staff to buy recycled products.

EXTENSIONS

A. For more sophisticated methods of making paper in the classroom, see chapters 4–10 in Arnold E. Grummer’s book *Paper by Kids*, as well as other references listed in the “Resources” section. You can assign groups of students to try some of the paper

variations described in chapters 6–8 in *Paper by Kids*. These include making decorative paper using thread, leaves, dried flower pieces, and dyes.

- B. Have students select colors of paper from which to make recycled paper and to predict the final color the color blends will produce.
 - C. Allow the paper in the recycle bin to stack up for a week or two. Let the children guess how far the stack will grow. Mark their predictions on a chart. Repeat this activity throughout the year; make it a goal to reduce the size of the stack.
 - D. Keep track of how many pounds of paper you recycle in the classroom in one month. Make a chart and post it beside your class's recycling bin. How many pounds of paper was saved? How many could the whole school save? (Each ton of paper replaces and preserves about 90 tons of wood from trees.)
- Note:** It is difficult to calculate the number of trees this represents, because the size and type of trees used for paper vary.
- E. Have a student conduct research on the paper wasp.
 - F. Have students find information on the history of paper and make a report to the class. (See "A History of Paper" in the "Appendix.")

RESOURCES

Video

Recycling: The Endless Circle. Washington, D.C.: National Geographic, 1992 (25 minutes).

Explains how recycling returns used materials to make new products, therefore reducing waste. The processes involved in recycling paper, aluminum, and plastic are described.

Books

Davis, Wendy. *From Tree to Paper*. Littleton, Mass.: Scholastic, 1995.

Describes the steps for manufacturing paper.

Brandt, Keith. *Discovering Trees*. Mahwah, N. J.: Troll Communications, 1982.

Describes the importance of trees.

Grummer, Arnold E. *Paper by Kids*. Minneapolis, Minn.: Dillon Press, Inc., 1980.

Describes a variety of ways that children can make recycled paper.

Lauber, Patricia. *Be a Friend to Trees*. New York: HarperCollins Children's Books, 1994.

Describes the importance of trees (food and habitat for animals, oxygen), including ways trees are used by people (for wood, paper).

Showers, Paul. *Where Does the Garbage Go?* Let's-Read-and-Find-Out Science series. New York: HarperCollins Children's Books, 1994.

Describes how materials can be recycled into new products.

Toale, Bernard. *The Art of Papermaking*. Worcester, Mass.: Davis Publications, 1983.

Describes various papermaking techniques.

Udry, Janice May. *A Tree Is Nice*. New York: Harper and Row, 1956.

Describes ways trees are important.

Weidenmuller, Ralf. *Papermaking: The Art and Craft of Handmade Paper*. Translated by John Kalish. San Diego, Calif.: International, 1984.

Describes various papermaking techniques.

Magazines

Powell, Jerry. "Hand Papermaking: Recycling Education at Its Best." *Resource Recycling*, (Jan./Feb., 1989), pp. 30-33 and 49.

This issue describes how to make recycled paper.

The Story Kids F.A.C.E., Illustrated. Nashville, Tenn. Vol. 8, Issue 2, (February/March, 1997). 1-800-952-3223; kidsface@mindspring.com

This issue describes how to make recycled paper.

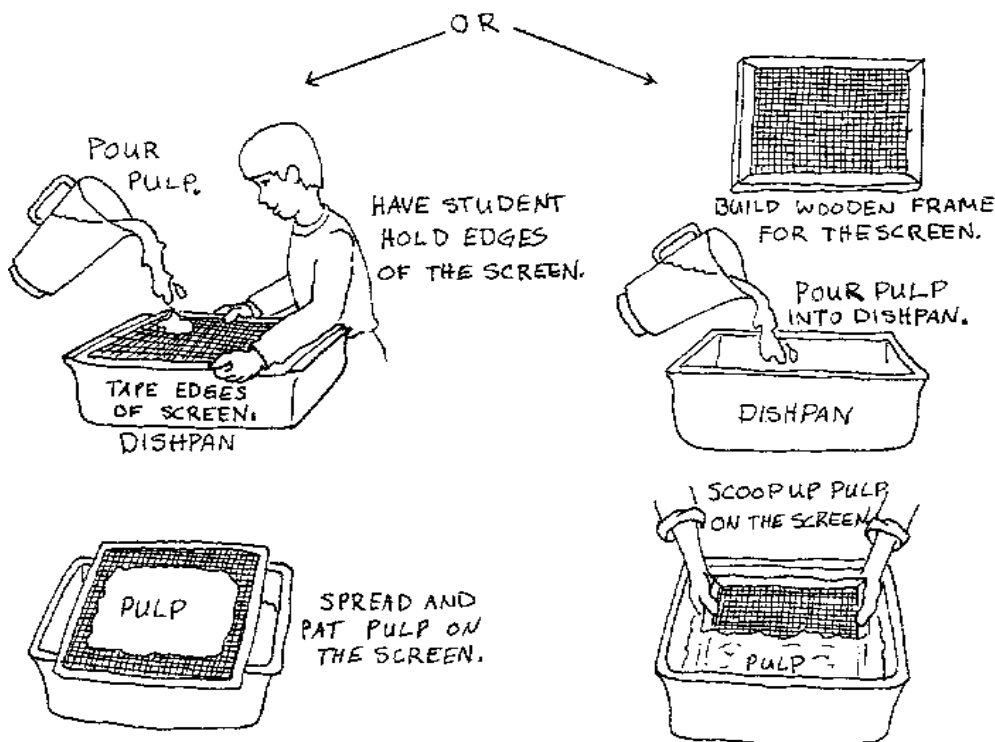
Website

The Technical Association for the Pulp and Paper Industry (TAPPI) has information about paper and paper making. TAPPI's web site is: <http://www.tappi.org>.

STEPS TO MAKE RECYCLED PAPER

1. Place torn up paper in a blender until the blender is half full.
2. Cover the paper with water. The ratio is usually one part paper to two parts water. If the paper is not blending easily, you may need to add more water.
3. Blend until the paper has been ground into a slightly runny oatmeal-like consistency. Make sure it is not too thick. This mixture is called pulp slurry.
4. If the screen has a frame, pour the pulp slurry into a dish pan. Scoop the pulp with the screen. Spread and pat the pulp on the screen.
5. If the screen does not have a frame, one student should hold the screen taut over an empty dish pan while another student pours the pulp slurry from the blender over the screen. The water should drain through the screen, into the dish pan. Spread and pat the pulp on the screen.
6. Place a couple of pieces of newspaper in the working area and place the screen and pulp on top of them.

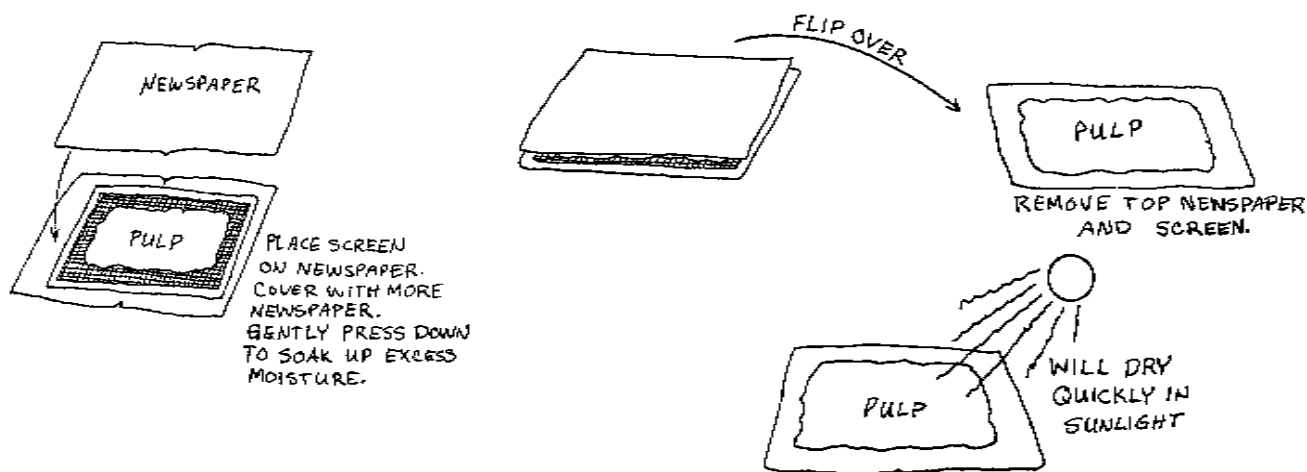
Optional: Press items, such as flowers, leaves, tissue paper, berries, into the recycled paper.



7. Use a couple of pages of newspaper and gently press down on the paper to soak up the excess water or use dishtowels (because the newspaper could leave black ink on white recycled paper).

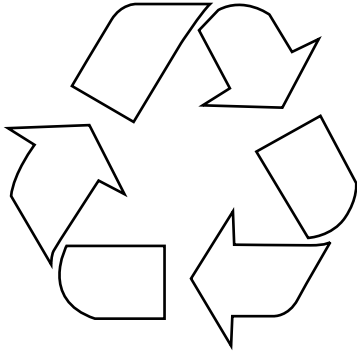
Note: If the paper is pressed too hard, the pulp will separate. At this point you can patch up the holes. Or remove the pulp, roll it into a ball, place it back on the screen, cover with newspaper, and gently press the pulp out again. If the pulp has become too dry, you will need to resoak it in the dishpan.

8. Flip everything over (like flipping a pancake). Remove the newspaper from the top and gently lift off the screen. The recycled paper will be resting on top of the newspaper used to soak up the excess water.
9. Place the recycled paper and newspaper in an area to dry (it will dry quickly in the sun). If drying overnight, place a heavy object, such as a book, on the paper to keep it from curling. The recycled paper should lift off easily from the newspaper when it is dry.

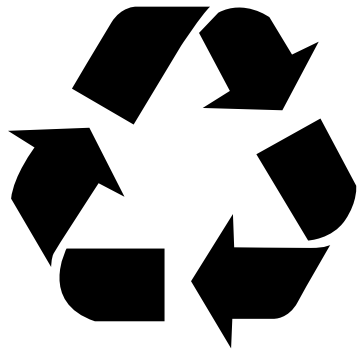


CLOSING THE LOOP

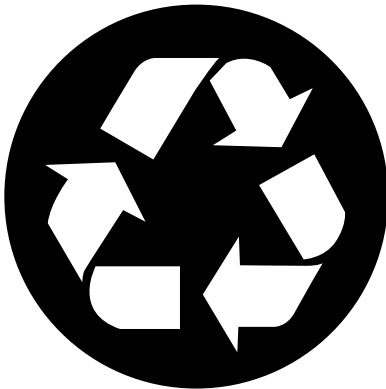
THE MEANING OF RECYCLING SYMBOLS



Carton or paper can be recycled.



The paper is made from recycled paper fibers of a stated percentage and can be recycled.



The package is made from 100% recycled materials, and can be recycled.

Each arrow within the recycling symbol represents one step; collection, manufacturing, and purchasing of recycled content materials, in the three-step process. All three are necessary to achieve “Closing the Loop”.

BACKGROUND INFORMATION FOR THE TEACHER

Wood that is unsuitable for use as lumber and lumber mill wastes are used to manufacture paper. To save transportation costs, paper mills are usually located near the forests where the wood is harvested. The trees are debarked, chipped, mixed with chemicals, and processed in a large steam-heated pressure cooker called a digester. This helps to break the wood down into cellulose fibers. The fibers are then rinsed with water to remove chemicals, unwanted wood contaminants, and dirt.

The remaining water-wood mixture, called slurry, is fed onto a screen and shaken to intermesh the cellulose fibers. Water is drained through the screen, and the remaining sheet of paper passes through a series of rollers where it is pressed. Heated rollers dry the paper. The dried paper is cut and placed on smaller rolls or cut into large sheets.

In 1995 approximately 31 percent of residential waste consisted of paper.¹ This wastepaper could have been recycled. The paper recycling process is very similar to the process of making paper from trees. The paper is chopped up and mixed with water to make a pulp slurry. Then it is put through a series of washing and/or flotation de-inking processes in which water and/or soap-like chemicals (called surfactants) remove the ink from the paper. Water is drained through the screen, and the remaining sheet of paper passes through a series of rollers where it is pressed and dried. The paper is slit into smaller rolls or large sheets. Later it is cut to desired size.

A single piece of paper may contain new fibers as well as fibers which have already been recycled. Papermaking fibers can typically be recycled five to seven times before they become too short to be recycled again.

Successful recycling requires clean recovered paper which is free of contaminants such as food, plastic, metal, and other garbage. Contaminated paper can introduce impurities and

bacteria into the recycling process. Also, different types (or grades) of paper, such as corrugated boxes, newspapers, and office paper, are kept separate because the different grades of paper are used to make particular types of recycled paper products.²

Recycling paper conserves natural resources. It saves trees (most of which are grown on tree farms). It saves energy, because it takes 30 to 60 percent less energy to produce the same weight of recycled paper as to make the paper from trees. It reduces air pollution from pulp mills by 74 to 95 percent and lowers water pollution by 35 percent. It also reduces the amount of paper going to the landfill, therefore, extending the life of the landfill.³

In this lesson students will be making their own recycled paper. Making recycled paper not only teaches students about the recycling process, but it is also a lot of fun.

Note: For additional information about paper see “The Paper Recycling Process” and “History of Paper” in the “Appendix.”

The symbol depicting that a carton is made from recycled paper is white arrows superimposed on a black circle. Three black arrows printed without any circular background also indicates that the paper is made from recycled paper fibers. Three white arrows (with black outline), only with no black circular background, means that a package is recyclable, although it may not be made from recycled materials. The three arrows depict the collection, manufacture, and purchase of recycled materials.⁴

In this lesson students will be making their own recycled paper. Making recycled paper not only teaches students about the recycling process, but it is also a lot of fun.

²“Secondary Fiber Recycling.” Atlanta, Ga.: TAPPI Press, 1993.

³G. Tyler Miller, Jr. *Environmental Science: Working with the Earth* (Fifth edition). Belmont, Calif.: Wadsworth Publishing Company, 1995, p. 346.

⁴E-mail communication from Brian Foran, Associate Waste Management Specialist, California Integrated Waste Management Board, August 26, 1998.

¹“Estimated Average 1995 Residential Disposed Waste Stream Composition.” California Integrated Waste Management Board.

NOTES